mates, was 0.362 degrees. The intraclass correlation coefficient (ICC) for a single technologist (between image variation) was 0.962 and for between technologists was 0.946.
Conclusions: The AA can be assessed using the workflow software with sufficient precision to be used in clinical trials. The test/re-test variability of AA measurement using this workflow tool assessed as the between image ICC is similar to figures previously reported [1]. AA measurements using such a tool may provide a useful eligibility assessment to make inclusion/exclusion decisions on patients who have excessive varus or valgus during the screening phase of a trial in KOA.

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GAGCEST: ASSESSMENT OF GAG IN CARTILAGE VIA CEST

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Purpose: Characterization of CEST approach in model systems and bovine cartilage
Methods: In 1H NMR spectroscopic analysis (HR-MAS, TOCSY, HSQC) of PG, we identified both amide and hydroxyl protons as possible chemical exchange saturation transfer (CEST) agents. Along with these labile sites, there exist two nuclear Overhauser effect (NOE) induced sites at the upfield of water signal. We distinguish the NOE sites from labile sites upon its different behavior with the existence of bulk D2O. To validate the applicability of CEST on cartilage, the cartilage itself was used to construct z-spectra instead of phantom. A bovine patellar cartilage tissue was then also evaluated ex vivo for gagCEST's ability to detect [GAG] variation on a 3T scanner. The exacted CEST image contrast demonstrates its applicability to detect variation of [GAG].
Results: Both amide and hydroxyl protons were identified using NMR spectroscopy using temperature variation approach. NOE sites and labile sites act similar in the presence of bulk water while opposite in presence of bulk D2O: the labile sites diminish while NOE sites enhanced according the equation:
NOEH2O=T1*Omiga*Iz
Where Iz denotes the magnetization from GAG; Omiga is the cross-relaxation constant between water and GAG. Omiga is negative due to the slow motion of GAG. The CEST effect was demonstrated on z-spectra of cartilage trypsinization series, along with asymmetric plot and CEST vs. [23Na] plot. The CEST results of intact and depleted cartilage samples were consistent with a decrease in [23Na]. The OH based CEST effect is almost linear with [23Na] while NH based CEST shows complications. The amide proton, however, should be further explored due to its uniqueness to GAG species. CEST-enhanced images of bovine cartilage at 3T clinical scanner demonstrate the feasibility of the approach for clinical translation.
Conclusions: 1H MRI with chemical exchange saturation transfer (CEST) proves to be a powerful method for diagnosing the early degenerative changes in cartilage tissue. The CEST based on OH at +1.0ppm downfield to water contrast has been shown to be sensitive to PG concentration. The high efficiency, specificity, and totally non-invasiveness make it a natural choice for many GAG based application.

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DIAGNOSING HAND OSTEOARTHRITIS FROM DIGITAL PHOTOGRAPHS: A REPRODUCIBLE SCORING SYSTEM

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Purpose: To develop a standardised scoring system for the diagnosis of hand OA from high quality hand photographs.
Methods: Participants in the study were randomly selected from those enrolled in the AGES-Reykjavik Study. 160 males and 221 females aged 69-92 participated. A Fuji Finepix 6800 zoom camera was used for all subjects with images taken at 2800x2200 pixels. Dark velvet board with two small central markers was used for hand positioning. The camera was mounted on a tripod at a fixed distance. The hands were placed palm down with the thumbs in moderate abduction and the thumbtips on the central markers and the other fingers slightly separated. All photographs were read by two readers (GPH and HJ).
Ten hand joints on each hand were read for evidence of OA. For practice, photographs were scored repeatedly by the two readers, independently and together. The joints were graded with regards to the visual signs of the presence of OA, such as hard tissue enlargement, deformity and visible soft tissue swelling. For the CMC1 joint, thumb positioning was also taken into account. Each of the 20 joints was classified as having one of the following grades: 0= normal joint with no evidence of hand OA, 1= Mild, some evidence of hand OA but not fulfilling the criteria for definite disease, 2= Definite moderate OA and 3= Severe hand OA. Radiographic results were used to aid the standardization. Subsequently, a consensus score was reached for each joint and a reference photo collection was then composed.
Results: Agreement between observers for assessment of individual joints was only moderate at first, but improved with practice and with the use of reference photographs. Final interobserver Kappa (on/off) values ranged from 0,79-0,88 and the Average Measure Intraclass Correlation Coefficient (ICC) from 0,80-85 for the individual DIP joints. For the PIP joints, the numbers ranged from 0,84-0,97 and 0,78-87, respectively. Kappa on/off for the CMC1 joint was 0,88 and the ICC 0,89. Intraobserver agreement values were slightly higher than the interobserver values. Two point differences in scores were recorded in less than 4% of cases. Spearman's correlation coefficient for aggregate scores was 0.78 (0.81 for females and 0.72 for males).
Conclusions: First results of photographic readings for diagnosing hand OA from the AGES-Reykjavik study show acceptable reproducibility and agreement between observers with the use of a reference photo collection. Hand photography may be useful as a screening tool in population studies.

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DETECTION OF BASIC CALCIUM PHOSPHATE CRYSTALS IN THE SYNOVIAL FLUID OF PATIENTS WITH OSTEOARTHRITIS

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Purpose: Basic calcium phosphate (BCP) crystals are found in up to 70% of osteoarthritic(OA) joints and current data suggests that intra-articular BCP crystals represent a potential therapeutic

target in OA. No simple test for BCP crystals is currently available and their detection is difficult due to their small size (nm) and the complexity of the synovial fluid (SF) samples in which they are found. BCP crystals usually remain undetected under conventional light microscopy. Unlike other high-resolution microscopic and spectroscopic techniques, atomic force microscopy (AFM) and Raman spectroscopy offer the advantage of portability, simplicity and relatively inexpensive instrumentation. The aim of our group is to develop novel analytical methods for the detection of BCP microcrystals in SF samples based on AFM, Raman and colorimetry.

Methods: Spiked samples were prepared by adding synthetic BCP crystals into control (crystal-free) synovial fluid in concentrations found *in-vivo*. Patient samples were aspirated from the affected joints (mainly knees and shoulders) of patients with OA. Control SF samples were either from the knee joints of patients with early rheumatoid arthritis since these synovial fluid samples rarely contain BCP crystals or from sports injury knee patients e.g. patients undergoing arthroscopy. AFM data was collected on a AFM microscope (Molecular Imaging) on "tapping mode". Raman measurements were performed on a μ-Raman microscope (785 nm excitation, Renishaw) on synthetic BCP crystals as well as on spiked, OA and control SF samples. Colorimetric testing was carried out by exposing SF samples to a number of crystal-specific stains (e.g. alizarin, molybdate blue, o-cresolphthalein complexone).

Results: AFM revealed the presence of small spheroids of inorganic-like material of the size expected (nm) of BCP crystals in samples from patients with severe OA. These features were not observed in control SF samples. Raman spectral features indicated that there are certain marker bands that are specific to the BCP crystals (such as the phosphate stretching mode at 960cm^{-1}) which are absent in Raman spectra of SF containing calcium pyrophosphate dehydrate (CPPD) and monosodium urate (MSU) crystals. Furthermore, CPPD and MSU also showed specific signature modes at 1043 and 1068 cm^{-1} respectively. Colorimetric testing indicated the presence of BCP in OA SF, and could distinguish between BCP, CPPD, MSU and calcium oxalate crystals.

Conclusions: All three approaches offer potential routes towards a simple and objective diagnostic test for the detection of BCP crystals in SF as a tool for improved diagnosis and characterisation of osteoarthritis. Furthermore, we believe that these techniques would be particularly suitable for point-of-care and clinical applications.

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ULTRASONOGRAPHY AS A TECHNIQUE TO DIAGNOSE AND MONITOR SYNOVITIS IN PATIENTS WITH OSTEOARTHRITIS: RESULTS WITH CHONDROITIN SULFATE

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Purpose: Ultrasonography (US) has proved more sensitive than clinical exploration for synovitis detection and has been used successfully as therapeutic monitoring system in rheumatoid arthritis in numerous published studies.

Chondroitin sulfate (CS) is an important constituent of most vertebrate tissues. CS belongs to the group of glycosaminoglycans, important structural constituents of cartilage extracellular matrix. Controlled clinical trials evidence the symptomatic efficacy and safety of this drug in osteoarthritic patients.

Recently, CS has also proved to be effective in patients with OA and synovitis (data from the Glucosamine and Chondroitin Arthritis Intervention Trial -GAIT-). In this study, synovitis assessment was conducted by means of clinical exploration. The aim of the present study was to monitor by US the efficacy of CS in patients with OA and associated synovitis.

Methods: An observational study monitored with US for 6 months was conducted in 20 patients with OA and unilateral knee synovitis, defined according to OMERACT criteria 2004. Among all patients, 9 presented grade 2 OA according to the Kellgren & Lawrence (KL) scale and 11 presented KL grade 3. All patients received treatment with 800 mg CS/day. Ultrasonographic controls were conducted at baseline and after 1, 3 and 6 months by a single observer specialized in US. The contralateral knee was used as control.

Results: In 8 out of the 9 patients with KL grade 2 and in 7 out of the 11 patients with KL grade 3 a progressive remission of synovitis was observed, evident from the 3rd month onwards. None of the contralateral knees developed synovitis. In one patient with KL grade 2 there was no complete remission, with persisting effusion, though less severe than at baseline. In 5 patients with KL grade 3, full doses of NSAIDs were necessary for a period of 21 days.

Conclusions: US allows synovitis detection in osteoarthritic patients and can be used as a therapeutic monitoring system of the inflammatory activity in OA. CS at the dose of 800 mg/day is an effective treatment to control synovitis in patients with OA, confirming previous data from the literature.

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COMPARISON OF QUADRATURE AND PHASED ARRAY MR KNEE COILS FOR MEASUREMENT OF QUANTITATIVE CARTILAGE MORPHOMETRY

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Purpose: Purpose: To compare the 3D cartilage segmentation performance of a quadrature transmit-receive extremity coil (USA Instruments (Aurora OH)) and a phased array coil with quadrature transmit, 8 channel receive extremity coil (InVivo Corporation (Orlando FL)) using semi-automated analysis methods.

Methods: Measurements of cartilage volume, thickness, and surface area were made using 10 (5 normal and 5 OA) subjects. Eight subjects had unilateral knee acquisitions and 2 received a bilateral scan, which provided a total of 12 knees for analysis. The data were acquired as part of the Osteoarthritis Initiative (OAI) pilot MR study. Each knee was imaged twice with each coil, for a total of four acquisitions, on a 3 Tesla Siemens Trio scanner using sagittal 3D DESS (0.365mm x 0.456mm, 0.7mm slice thickness, TR 16.5msec, TE 4.7msec).

The MR images were analysed using a semi-automated cartilage segmentation software that provided measurements of cartilage volume, thickness, and surface area. We performed two analyses. To test the hypothesis that a non-uniform receive (phased array) coil could be used to segment cartilage, the "intra coil" reproducibility was determined using duplicate scans from the same coil. Scans for the intra coil reproducibility were read in a paired manner whereby the reader was unblinded to patient for